

The Patent Application of

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TITLE OF THE INVENTION

Quick Change Jaw Plates for Machine Tool Vices

CROSS REFERENCE TO A RELATED APPLICATION

This application is a continuation of U.S. Patent Application No.
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FIELD OF THE INVENTION

[0001] This invention relates to quick change jaw plates for machine tool vices.

BACKGROUND OF THE INVENTION

[0002] Computer numerical control (CNC) machines such as CNC multi-axis
milling machines used primarily for machining metallic parts are costly but very
productive. CNC machines fashion metal parts by performing programmed
machining operations with a high degree of precision and repeatability.

Accordingly, the productivity of a CNC machine depends in large part on the amount of time a machine is actually performing operations as opposed to the amount of time needed to change over from a job to a subsequent job. The time needed to change between jobs is known as change over time or set up time. The productivity of a CNC machine increases as change over time decreases.

[0003] In order to reduce change over time, CNC machine operators have adopted opposed jaw vices which carry removable jaw plates. Typically, the jaw plates are fashioned from blocks of an easily machinable material such as aluminum and are typically machined with features for securing a particular type of workpiece. The jaw plates typically include counter sunk bolt holes for receiving bolts so that the jaw plates may be bolted to the opposing jaws of a vice.

[0004] Unfortunately, the operations of installing and removing the bolts of bolt mounted jaw plates adds to change over time. Further, the bolt mounting of jaw plates does not result in the accurate, repeatable mounting of jaw plates.

Accordingly, workpieces, when held by bolt mounted jaw plates, must be indicated in to determine their exact location and orientation in relation to the machine.

Moreover, typical bolt mounted jaw plates are arranged so that bolts are open to the workpiece side of the jaw plate. This reduces the jaw plate area available for securing a workpiece and exposes the bolts and the counter sunk bolt holes to machine debris. What is needed is a jaw plate which can be changed over very

quickly and which can be located relative to a vice with a high degree of accuracy and repeatability. What is also needed is a jaw plate which presents a gripping surface which is not interrupted by bolts and the countersunk bolt holes needed for receiving them.

BRIEF SUMMARY OF THE INVENTION

[0005] The aforementioned needs are addressed by providing quick change vice jaw plates which have no fastener openings on their exposed faces and which can be rapidly secured to and rapidly removed from the opposing jaws of a vice. The quick change vice jaw plates are for mounting to the jaws of a vice that include spaced jaw plate retainers. The jaw plate retainers each carry a protruding retaining pin which is biased toward the face of the jaw. Each retaining pin includes a narrow shank and a relatively wider head and a frustum cone shaped portion transitioning between the narrow shank and the wider head. Each jaw plate has spaced retention recesses for receiving the heads of the retaining pins. Each retention recess includes a wide portion for receiving one of the retaining pins, a relatively narrow slot portion having ramp shaped shoulders for pulling the head of the retainer pin away from the jaw face as the jaw plate slides relative to the vice jaw and a compatibly shaped detent portion for securely receiving the head of the retaining pin.

[0006] The quick change vice jaw plates may be quickly secured to the vice jaws by placing the wide portions of the retention recesses over the retaining pin heads and sliding the jaw plates until the retaining pin heads seat in the countersunk portions of the retention recesses. The jaw plates may be rapidly removed from the vice jaw by tapping on the jaw plates to cause the heads of the retainer pins to pop back up into the slot portions of the retention recesses thus making it possible to disengage the retaining pins through the wide portions of the retention recesses. Thus, jaw plates adapted for holding workpieces may be rapidly and repeatably mounted to a compatible vice jaw without the use of hand tools except for perhaps a common rubber mallet. Because it is not necessary to access the retaining pins with a tool when a quick change jaw plate is installed or removed, the retention recesses can be machined in an undercut fashion from the surfaces that mate with the vice jaw so that the workpiece mating surfaces of the jaw plates can be free of bores or recesses for accessing fasteners. This eliminates pockets for accumulating machining debris and frees additional surface area for fashioning part holding features.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0007] FIG. 1 is a perspective view of a prior art vice with prior art jaw plates.

[0008] FIG. 2 is a perspective view of a vice with quick change jaw plates.

[0009] FIG. 3 is a perspective view of a vice with quick change jaw plates.

[0010] FIG. 4 is a perspective view of a quick change jaw plate.

[0011] FIG. 4A is a side view of a quick change jaw plate.

[0012] FIG. 4B is a cross section view of a quick change jaw plate taken from plane B-B of FIG. 4A.

[0013] FIG. 4C is an end view of the quick change jaw plate of FIG. 4A.

[0014] FIG. 5 is a cross section view of the quick change jaw plate, a vice jaw and a jaw plate retainer.

[0015] FIG. 6 is an exploded cross sectional view of the quick change jaw plate and a jaw plate retainer.

[0016] FIG. 7 is a longitudinal cross section view of the quick change jaw plate shown with an empty retention recess and a retention recess that has captured a jaw plate retainer.

[0017] FIG. 8 is a magnified detail taken from FIG. 7 providing a magnified view of a retention recess.

DETAILED DESCRIPTION OF THE INVENTION

5 [0018] Turning now to the drawings, wherein like reference numerals identify identical or corresponding elements, and more particularly to FIG. 1 thereof, a vice 6 is shown to include a base 7, a stationary vice jaw 5A and a translating vice jaw 5B. In FIG. 1, a prior art jaw plate 8A is shown aligned for mounting stationary
10 vice jaw 5A. A second prior art jaw plate 8A is shown mounted to sliding vice jaw 5B. Prior art jaw plate 8A includes countersunk holes 8B for receiving threaded fasteners 9. Stationary vice jaw 5A and sliding vice jaw 5B also include bolt holes (not shown) for receiving fasteners such as fasteners 9. With the prior art arrangement shown in FIG. 1, jaw plates 8A are bolted to stationary vice jaw 5A
15 and translating vice jaw 5B. Preferably, jaw plates 8A and 8B are fashioned from an easily machinable material. Although not evident in FIG. 1, opposed workpiece clamping surfaces 8C and 8D of vice jaw plates 8A are typically machined with features which are uniquely shaped for engaging a compatibly shaped workpiece.

20 [0019] FIG. 2 illustrates the quick change jaw plate arrangement 10 of the present invention including vice 6 and jaw plates 50. Vice 6 of FIG. 2 also includes base 7, stationary vice jaw 5A and translating vice jaw 5B. With quick change jaw plate

arrangement 10, fasteners 9A have been replaced by jaw plate retainers 12. Jaw plate retainers 12 are compatible with bolt holes 5A1. However, jaw plate retainers 12 differ from fasteners 9 of FIG. 1. Each jaw plate retainer 12 includes an externally threaded housing 14 with external threads like those of fasteners 9A.

5 Housing 14 is generally hollow for carrying a biased retaining pin 26. Retaining pin 26 is biased so that it is pulled down into housing 14. Each jaw plate 50 includes a jaw mating surface 52, a workpiece clamping surface 54 and a pair of retention recesses 80. Generally, each retention recess 80 is undercut in jaw mating surface 52 and is shaped and located to receive and mate with the head of spring biased
10 retaining pin 26 such that jaw plate 50 may be slid into a fixed, repeatable position, preferably by means of a the tapping action of a mallet 101 as shown in FIG. 3, and such that jaw plate 50 may also be easily disengaged by means of a strike from mallet 101 in a reverse direction from that shown in FIG. 3 and thereby removed from a vice jaw.

15 [0020] FIGs. 4 - 4C, and FIGs. 7 and 8 provide more detailed views of jaw plate 50 and retention recesses 80. FIG. 4 shows that jaw plate 50 includes a workpiece clamping surface 52, a jaw mating surface 54 and retention recesses 80 which are spaced on jaw mating surface 54 to match the spacing of jaw plate retainers 12.

20 [0021] Each retention recess 80 is fashioned so that it can receive, retain and release the head of retaining pin 26. Retention recess 80 can be understood in a

general fashion as including undercut features fashioned to define a receiving portion for receiving the head or retaining pin 26 and a guiding portion for guiding the head of retaining pin 26 to a pocket like detent portion which receives the biased head of retaining pin 26 and holds it in a fixed position. Also, generally, the
5 detent portion of retention recess 80 is shaped so that when a sharp, jolting force, such as may be applied with a mallet, is applied to the jaw plate from the general direction of the retention recess receiving portion, retaining pin 26 pops up and out of the detent portion so that it can exit the retention recess.

10 [0022] A more detailed understanding of the geometry of retention recess 80, in the preferred embodiment, can be gained by referring to FIGs. 4-4C and FIGs. 7 and 8 and can be understood in a more particular fashion as including a recessed face 81, a relatively wide portion 82 for receiving the head of a retaining pin 26, a relatively narrow slot portion 84 and a detent portion 86. Relatively narrow portion 84
15 features opposite ramp shaped shoulders 84A and 84B which are spaced and shaped to receive and raise the head of retaining pin 14 against its bias. Shoulders 84A and 84B are spaced widely enough to receive the shank portion of retaining pin 26 but narrowly enough to catch the wider head portion of retaining pin 26. Detent portion 86 is compatibly shaped in the form of a cone frustum pocket for receiving
20 and retaining the cone frustum shaped portion of retaining pin 26. The various above described features of retention recess 80 are shaped so that jaw plate 50 can be gently tapped into place as the heads of spaced retaining pins 26 slide up

shoulders 84A and 84B of each respective retention recess 80 and then seat into each detent portion 86. This provides for the accurate repeatable location of jaw plate 50 in two axis parallel to the faces of the vice jaws. The pressure applied by the opposed vice jaws against the jaw plates prevents movement in the third axis.

5 The various features of retention recess 80 are also shaped so that jaw plate 50 can be quickly removed by tapping on jaw plate 50 from the direction opposite countersunk portions 86 to cause the heads of retaining pins 26 to jump back up onto shoulders 84A and 84B of each retention recess 80 so that jaw plate 50 may be disengaged from jaw plate retainers 12.

10 [0023] FIGs. 5 and 6 provide detailed views of jaw plate retainer 12. Jaw plate retainer 12 generally includes a housing 14 which is externally threaded with external threads 14A for mating with a standard vice jaw bolt hole. Jaw plate retainer 12 also includes a protruding retaining pin 26 which can move within
15 housing 14 between an extended position and a retracted position and which is biased toward the retracted position by a spring 24. As can be best seen in the preferred embodiment shown in FIG. 6, retaining pin 26 further includes a bolt portion 27 and a head portion 28. Head portion 28 includes a narrow shank 28A, a wider head 28B and cone frustum shaped portion 28C which transitions between
20 shank 28A and head 28B. Shank 28A has a threaded bore 28D extending from its end for receiving bolt portion 27. Housing 14 further includes a radial flange 14B which is sized to fit within recessed face 81 of retention recess 80 and a central bore

14C. Central bore 14C of housing 14 is further divided into a narrow distal portion 14D and a wide proximal portion 14E. Distal portion 14D of bore 14C is machined to close tolerances to slidably receiving shank 28A of head portion 28 of retaining pin 26. Proximal portion 14E of bore 14C is fashioned to receive a compression spring 24 and bolt portion 27 of retaining pin 26. Compression spring 24 pushes against the head of bolt portion 27 thus biasing head portion 28 of retaining pin 26 in the same direction. As can be seen in FIG. 5, compression spring 24 pulls head portion 28 down into housing 14. If each head portion 28 of as spaced pair of retaining pins 26 are located within each detent portion 86 of a compatibly spaced pair of retention recess 80 as shown in FIG. 5, then jaw plate 50 will be accurately and repeatably mounted to vice jaw 5A.

[0024] Now that the various part of the quick change vice jaw have been described, the installation and removal of a quick change vice jaw can be considered. This description of the installation and removal of a quick change vice jaw will avoid plurals whenever possible. The reader should understand that this description relates to the installation of preferably two quick change vice jaws on opposed vice jaws and that vice jaws are preferably substantially identical and each preferably includes at least two retention recesses which are compatibly spaced to interface with at least two corresponding jaw plate retainers. It should also be understood that the jaw plate retainers may be threaded into at least two standard bolt holes 8A1 spaced apart by a standard distance and disposed in the opposing faces of the

vice jaws. As noted above, jaw plate retainer 12 has an externally threading housing 14 and is adapted to mate with a typical threaded bores 8A1 of a vice jaws 5A shown in FIG. 2. Before a quick change jaw plates 50 can be mounted to vice jaw 5A or 5B, two jaw plate retainers 12 are threaded into bolt holes 8A1 such that each radial flange 14B is flush against the surface of vice jaw 5A..

[0025] Once, jaw plate retainers 12 are in place, it is possible to mount a jaw plate 50 to a vice jaw 5A. To understand the mounting of one jaw plate 50 it is best to consider the action of one retention recess 80 of a jaw plate 50 relative to one jaw plate retainer 12.. To mount jaw plate 50 to a vice jaw such as vice jaw 5A, the jaw plate 50 is mated with a vice jaw so that a retention recess 80 is placed over a jaw plate retainer 12 so that flange 14B of jaw plate retainer 12 is received by recessed face 81 and such that head 28C of retention pin 26 is received by wide portion 82 of retention recess 80. Jaw plate 50 is tapped with a mallet from the opposite direction of wide portion 82 (in the direction shown by arrow 51 in FIG. 7) so that the ramped shoulders 84A and 84B of narrow portion 84 of recess 80 engage and pull against surface 28C of retention pin 26 to cause retention pin 26 to pull away from housing 14 of retainer 12. Head portion 28 of retention pin 26 slides up ramped shoulders 84A and 84B until head portion 28B is captured by detent portion 86 of recess 80. This motion is indicated by arrow 61 and the jaw plate retainer positions indicated by 12 and 12' in FIG. 7. At this point, when two retention pins 26 are located so that they are captured by respective, compatibly spaced detent

portions 86, jaw plate 50 is retained against movement in the plane of the vice jaw face. If two opposite jaw plates which are retained in this manner are pressed together to hold a workpiece, their respective positions will be accurate and repeatable. Accordingly, if two opposite jaw plates are machined with special features for holding a particular workpiece, then the workpiece may be located relative to a machine in an accurate, repeatable manner thus eliminating the step of determining the position of the work piece in relation to the machine and thus reducing set up time as various jaw plates are interchanged between various machining tasks.

[0026] As can be seen from the above description of the installation of a quick change jaw plate 50, it is only necessary to position jaw plates 50 accurately and repeatably until vice jaws 5A and 5B apply a significant amount normal pressure which acts to hold the quick jaw plates 50 in a fixed position. When the pressure of vice jaws 5A and 5B is released, a jaw plate 50 can be removed with little effort. Accordingly, an operator can quickly remove a jaw plate 50 from a vice jaw such as vice jaw 5A with an action that is the reverse of the one described above. Namely, an operator may tap upon jaw plate 50 from the end opposite detent portions 86. This tapping on jaw plate 50 causes the head portion 28 of each retainer pin 26 to pop back up into the slot portion 84 of each retention recess 80. As the operator continues to tap or push on jaw plate 50, the head portions 28 of each retainer pin 26 proceed down the ramped shoulders 84A and 84B of each narrow portion 84

until head portions 28 align with the wide portions 82 of each retention recess 80.

At this point, the operator may pull jaw plate 50 away from vice jaw 5A.

[0027] Thus, jaw plates 50 in combination with jaw plate retainers 12 solve the
5 problems noted above. Jaw plates 50 may be rapidly removed and replaced with
other jaw plates so that a vice for securing workpieces for machining operations
may be quickly changed over between machining various parts. The corresponding
frustum cone shaped features of detent portion 86 of recess 80 and head portion 28
of retention pin 26 make it possible to accurately and repeatably locate a particular
10 jaw plate 50 on a particular vice jaw. When jaw plates are customized with specific
features for securing particular workpieces, an operator using the jaw plates and jaw
plate retainers of the present quick change jaw plate arrangement may repeatedly
return to a machining task, mount a particular workpiece and then run CNC
operations without the time consuming process of indicating in the position of the
15 workpiece relative to the CNC machine. Moreover, since it is not necessary to
access jaw plate fasteners as is the case with typical, prior art, jaw plates, the entire
surface area of jaw plate 50 is available for holding a workpiece. This
uninterrupted surface increases the versatility of the vice. The lack of workpiece
side fastener holes further reduces change over time because there is no need to
20 remove machining debris from workpiece side fastener holes. Accordingly, change
over time is significantly reduced so that productivity of a CNC may be
significantly increased.

[0028] It is to be understood that while certain forms of this invention have been illustrated and described, it is not limited thereto, except in so far as such limitations are included in the following claims and allowable equivalents thereof.